

# E706 CRYOSYSTEM DESIGN NOTE

## E706EN009

**TITLE:** Liquid Volume in the LAC

**AUTHOR(S):** KELLY DIXON

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**OBJECTIVE OF NOTE:** This note determines the liquid volume of the E706 LAC vessel when empty and when containing both detectors and excluders.

**ASSUMPTIONS:** The assumption is made that only the hadron detector, photon detector, and both excluders displace the liquid argon volume. Most dimensions were obtained from drawings from the mechanical group and CBI.

**CALCULATIONS:**

### Liquid Volume in the LAC

$$cyl.dia = 17ft$$

$$cyl.length = 13ft$$

$$head\ dia. = 17ft$$

$$head\ length = 2.63ft$$

$$\begin{aligned}
V_{\substack{\text{w/o} \\ \text{contents}}} &= \frac{\pi}{4}(17)^2 13 + \frac{\pi}{6}(2.63)[3(8.5)^2 + 2.63] \\
&= 2950 ft^3 + 308 ft^3 \\
&= 3258 ft^3 \\
&= 24,370 gals \\
V_{\substack{\text{hadron} \\ \text{plates}}} &= \frac{52[140.5(148) - \frac{\pi}{4}(17.5)^2 - 2(26.8)(59.5)]}{(12)^3} \\
&= 522 ft^3 \\
&= 3909 gals \\
V_{\substack{\text{hadron} \\ \text{cookies}}} &= \frac{53}{52} \left( \frac{1}{4} \right) (522 ft^3) \\
&= 133 ft^3 \\
&= 995 gals \\
V_{\substack{\text{photon} \\ \text{detect}}} &\cong \frac{\pi}{4}(11.5)^2(2.5)(0.5) \\
&\cong 130 ft^3 \\
&\cong 971 gals \\
V_{\substack{\text{frontal} \\ \text{excluder}}} &= 183 ft^3 (\text{given by G. Fanourakis}) \\
&= 1361 gals \\
V_{\substack{\text{central} \\ \text{excluder}}} &= \frac{(134)(16.6)^2 \frac{\pi}{4}}{(12)^3} \\
&= 16.8 ft^3 \\
&= 126 gals \\
\therefore V_{w/contents} &= 3258 - 522 - 133 - 130 - 183 - 17 \\
&= 2274 ft^3 \\
&= 17,101 gals.
\end{aligned}$$

**CONCLUSIONS:** Empty LAC volume is found to be 24,400 gallons and only 17,000 gallons when the detectors and excluders are added.

**REVIEWED BY:**

John Urbini  
Name

10 Sep 86  
Date

Kelly Dixon  
Project Manager

10 Sept 86  
Date